NEW METHODS

FLAT THERMOPILE

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We built a flat thermopile to register changes in the blood supply to the surface of organs (dura and pia mater, myocardium, kidney, etc.) according to the principle of the thermopiles of Noyons, Vestenrik and Engbled, for the bloodless determination of fluctuations in the volume flow of the blood in blood vessels. A diagram of the thermopile is shown in Fig. 1. The case for the thermopile is made of plexiglass in the shape of a thin disk (0.7 mm in thickness, 9 mm in diameter), to the rear surface of which is fastened a cylindrical box (6 mm in diameter, 3.0 mm high, with a wall thickness of 0.7 mm).

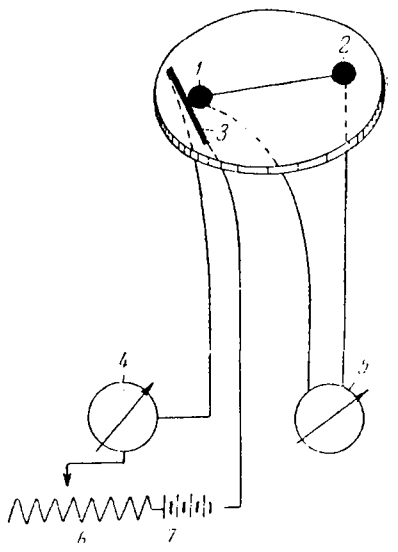

Fig. 1. Diagram of the flat thermopile: 1,2) thermocouples; 3) nichrome plate; 4) millammeter for determining the amperage heating the nichrome plate; 5) galvanometer; 6) rheostat; 7) battery.

Below the surface of the disk, two thermocouples, 1,2 (copper—constantan) of a differential thermopile project (Fig. 1). One of these thermocouples touches a thin nichrome plate 3, which also projects above the surface of the disk. The wires leading to the thermocouples and nichrome plate are immersed in the cylindrical box, which is then filled with plexiglass.

The nichrome plate is heated with electric current from the battery 7. The amperage is regulated with a rheostat 6 under the control of a milliammeter 4 (200-400 ma). As a result of heating the nichrome plate, heat is transferred from it to the thermocouple connected with it and, thanks to the difference in temperature, a thermoelectric current develops between thermocouples 1 and 2. The amount of thermoelectric current is determined by the indications of a galvanometer 5, with which the thermopile is connected.

Under otherwise equal conditions, the temperature of thermocouple 1 depends on the amount of blood flowing below it. The more blood flows, the more it is cooled, the less difference there is between the temperatures of thermocouples 1 and 2 and the less thermoelectric current is developed. Therefore the changes in the volume flow of the blood in the area of thermocouple 1 can be judged by the indication of the galvanometer (usually registered on a photokymograph).

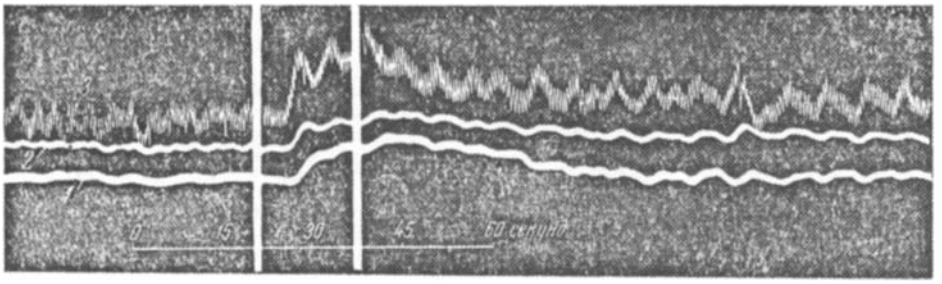

Fig. 2. Simultaneous registration of the volume flow of the blood in the coronary artery (1) and blood supply to the surface of the myocardium (with the flat thermopile) (2); curve 3 – pneumogram. Distention of the small intestine between the two vertical lines.

For convenience in fastening the thermopile to an organ, the disk is supplied with holes for silk threads.

In a number of experiments, simultaneous registration was carried out (on two galvanometers) of changes in the blood flow through the coronary artery with Noyons' thermopile and of the blood supply of the surface of the heart with the flat thermopile. As is seen in Fig. 2, the indications of both thermopiles coincided. The flat thermopile has been used many times successfully by us to register changes in the blood supply to the dura and pia mater. 8% formalin can be especially recommended. With this fixative, tissue shrinkage is insignificant and the most delicate acid mucopolysaccharide structures are clearly stained.

SUMMARY

A flat thermopile constructed according to the principle of the electrode of Noyons to register changes in blood circulation on the surface of organs (hard and soft meninges, myocardium, kidneys, etc.) is described.

Curves of the simultaneous registration of blood flow changes in coronary artery by Noyons thermopile and those of the simultaneous registration of blood supply of the heart surface by the flat thermopile are shown.